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ABSTRACT

This paper presents results evaluating the National Science Foundation's Comprehensive Assistance to Undergraduate Science Education (CAUSE) program focusing on: (1) institutional needs; (2) project implementation; (3) quality of instructional improvement; (4) evaluation; (5) project costs; and (6) recommendations. Evaluation methods included surveys, site visits, case studies, and content analysis of proposals. (Author/DS)

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AN EVALUATION OF THE CAUSE PROGRAM*

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Introduction

This morning we are going to present the results of an evaluation of the comprehensive assistance to undergraduate science education program - CAUSE. We have aimed our session at two groups: those interested in instructional improvement in postsecondary education and those interested in the evaluation of a federally-funded education program. Our papers will cover both topics. I will begin by portraying briefly the CAUSE program and the type of projects it funds. Next I will describe the framework of our evaluation. Richard Lent will present a discussion of the techniques of site visit and case study as we used them and the results from that level of data analysis. This is a combination of two papers listed in the AERA program--those by Coleman and Lent. The next paper describes the methods and results from surveys and content analysis of proposals. Finally, John Eggert will discuss conclusions and recommendations of the complete evaluation and reflect on the approach of the evaluation.

A Profile of the CAUSE Program

The CAUSE Program is a program in the division of science education resource improvement in the science education directorate of the National Science Foundation. It has three very broad goals: to strengthen undergraduate

SE 034 933

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science education resources; to improve the quality of instruction in science; and to enhance the institution's capabilities for self-assessment, management and evaluation of science education. The program has had about 13 million dollars annually which funds about 70 institutions a year with a grant. The amount of the grants varies from $30,000 to $250,000 with a large proportion at $250,000 and 45% receiving more than $200,000. Institutions must match one-third of this amount. Projects may be one to three years in length. About 75% are three years in duration. Projects at two-year and four-year colleges and universities, and college and university consortia are funded. The breakdown of projects at the different types of institutions is: 27% at two-year colleges; 41% at four-year colleges; 27% at Ph.D.-granting universities and 5% at consortia of colleges and universities.

Many projects involve more than one academic department. Some have an interdisciplinary approach involving several departments. While others consist of several small projects within one CAUSE project. They cover a wide variety of disciplines including social sciences.

The focus of projects is diverse. Generally they fall in one of the following categories: 28% are for curriculum additions and revisions; 27% are for equipment and materials purchase and facilities renovation; 24% are for computer applications and computer hardware and software acquisitions; 16% are for individualizing instruction and developing remedial instruction; and 3% are faculty development. Many projects cover more than one category. We found projects tried to meet certain kinds of problems or needs. For example, there is inadequate coverage of a discipline or a changing discipline; teaching methods are ineffective or inefficient; hardware, software, and facilities are inadequate; students are inadequately prepared, poorly motivated or have diverse backgrounds; and faculty need to update their skills.

The intention of CAUSE is to fund programs that are needed at the particular institution in question rather than strictly on new innovative projects on a national level. Below are some examples of CAUSE projects. These summaries are taken from site visit reports.*

The senior university in a nine-institution state system has a $250,000 CAUSE grant for three years. The CAUSE project at Willows University has supported the development of approximately 125 separate instructional modules to simulate and/or extend laboratory experiences in psychology. The course materials have been prepared by individual faculty, with the assistance of CAUSE project staff. The most striking characteristic of the project has been the project directors explicit consideration of project management concerns and his effective use of junior level staff in the areas of project evaluation and computer programming/instructional development.

A grant for $241,392 for three years was received by a small four-year liberal arts college to redesign courses and renovate laboratories to create a major in environmental science. Forestview College is renowned for its long history as a leading innovator in American higher education. In recent years, however, a series of financial setbacks, declining enrollments and other difficulties have seriously threatened the college's ability to survive. These problems came to a head recently when a cash-flow crisis almost closed the school for good. It is against this background of the college's traditional spirit and current difficulties that the conduct and outcomes of the CAUSE project must be understood.

A grant of $132,200 for three years was given to develop instructional computing modules. The computer Consortium for Higher Education Institutions includes fourteen colleges and universities in proximity to each other. The project funded computer time and student programmer time so that faculty members could develop new instructional computing materials to accompany their courses. A process of evaluation and review of proposed modules was instituted to insure that need for the modules was recognized by more than just one faculty member in the consortium. The great challenge to the staff and faculty on this project has been working in a consortium setting across geographical distance and institutional differences.

A two-year college located in a medium-sized city in the southwest received $186,275 for three years. College of the Mountains serves a large student population with a diversity of instructional programs. The CAUSE project at the institution was very specifically focused on a single course offering in the chemistry department and primarily involved the revision of audiovisual instructional modules for a two-semester introduction to Chemistry course.

*All the names of the institutions in these examples have been changed to fictional names.

Our Evaluation of the Program

We began our evaluation in September, 1978 and completed it last summer, 1980 under a contract to the Office of Program Integration. We focused on six major issues which are: institutional needs; project implementation; quality of instruction evaluation; project costs; and recommendations.

We formulated these issues as questions which are as follows.

1. To what extent are high priority institutional needs being met by local CAUSE projects?

2. How are the CAUSE projects being implemented? What are their strengths and weaknesses?

3. To what extent is the improvement of the quality of instruction occurring as a result of CAUSE?

4. What is the nature and quality of the evidence and the evidence collection and analysis procedures being used to determine the strengths and weaknesses of individual CAUSE projects?

5. What are the relative costs of the design, implementation and operation of activities within CAUSE projects, and how do they relate to post-CAUSE institutional support?

6. What policy changes and program modifications should be implemented in the CAUSE program?

These issues were drawn from issues and questions raised by the Office of Program Integration in their request for proposals, and from a six-month study for which we were funded by NSF. At that time we had an opportunity to visit CAUSE projects and interview staff, read proposals, solicitations, etc. Our own professional backgrounds are in instructional improvement, evaluation, and cost-effectiveness analysis in postsecondary education. We were assisted by a team of nine scientists.

In order to address these six issues we designed a framework for our evaluation. We chose methods at three levels of specificity and focus. The first perspective provided a broad view of all projects of 1976, 1977, and 1978.

The methods included a two-staged survey of project directors and an analysis of proposals. The second perspective was detailed but in-depth, and these consisted of two-day site visits to 17 projects. The third perspective is a close-up one based on repeated visits to eight projects over the period of a year.

We selected multiple perspectives and methods to emphasize redundancy in the data. The issues structured our investigations at each level of inquiry. Emphasis on different characteristics of the CAUSE program were shifted among the levels.

We sought accuracy in the data by asking the same question of different sources and under different conditions. We sought redundancy through the use of complementary data sources and data collection techniques.

The techniques used and the strengths and weaknesses are shown on the table entitled "Strengths and Weaknesses of Data Collection Methods.

An iterative process of discovery and verification was used to analyze the data. The discovery phase was the expansion of the data base using the methods of site visiting, casing, surveying and analyzing documents and proposals. The verification phase was one of reducing observations into categories and relationships among categories. We used this two phase process again and again.

For example, the six issues were derived during the planning of the evaluation. This was the first round of iteration. Then observations were gathered from the first survey, the analysis of proposals, and one quarter of the visits to projects. These findings were analyzed. Since these observations were gathered with instruments and interview protocols based on the six issues and their accompanying sub-issues, most were easy to organize into categories. However, we did have some that did not fit. We debated eliminating issues and sub-issues or restating them. We tried to understand the nature of these findings that didn't fit into our issues. Eventually we created some new

categories, but left the issues and sub-issues intact. We decided to examine the new categories again later.

After completion of the second survey and two-thirds of the visits to projects we worked again to analyze findings. Interestingly, the new categories proposed in the earlier iteration lost their ability to explain. The findings in those categories had changed, grown, or diminished in importance. The findings all fit under the original issues. Some of the original sub-issues were weak, however, finally when all data were collected, we conducted a final iteration of analysis. In the end the original issues and many of the sub-issues were used to organize our conclusions.

In Summary

The methodology of this evaluation was built on six issues: institutional need; project implementation; quality of instruction; evaluation; project costs; and recommendations. The framework of the evaluation emphasized redundancy and multiple perspectives in the data. The methods had three levels of focus: broad, medium, and narrow. Data collection techniques included: site visits, case studies, surveys, and content analysis of proposals. Data analysis used a naturalistic approach of iterations of discovery and verification.

The real challenge of this evaluation was a program represented by projects which fit general goals but have very different outcomes and operate in the context of different types of institutions. The opportunity was to study a large number of instructional improvement projects in postsecondary education.

Instructional Improvement in Science Education at the Postsecondary Level

In 1978 the National Science Foundation's Office of Program Integration awarded a contract to conduct an evaluation of the Comprehensive Assistance to Undergraduate Science Education (CAUSE) Program. CAUSE is a 13 million dollar annual funding program of the Science Education Directorate of NSF. The program encourages the improvement in quality and effectiveness of undergraduate science education in institutions of higher education. Any non-profit, degree granting institution or consortium of institutions in the United States is eligible to submit a proposal which may request up to $250,000 for a 3-year period.

CAUSE was established by Congressional Mandate in 1975, in the 1976 NSF Authorization Act. First awards were made in 1976. Therefore it is a relatively young program. In 1977 the Office of Program Integration at NSF began a two phase proposal process to let a contract to evaluate CAUSE. The purpose for the evaluation was defined as helping to ". . . generate information on the need, scope, impact, and conduct of the program in addition to indicating possible future implications, trends, policies, and theoretical issues." Three $10,000 planning grants for six months to develop evaluation designs were awarded. Based on these designs Office of Program Integration awarded the execution of the evaluation to Development and Evaluation Associates, Inc. (DEA).

DEA has spent the last two years conducting an evaluation of CAUSE which focused on the examination of six issues:

1. To what extent are high priority institutional needs being met by local CAUSE projects?
2. How are the CAUSE projects being implemented? What are their strengths and weaknesses?
3. To what extent is the improvement of the quality of instruction occurring as a result of CAUSE?
4. What is the nature and quality of the evidence and the evidence collection and analysis procedures being used to determine the strengths and weaknesses of individual CAUSE projects?
5. What are the relative costs of the design, implementation and operation of activities within CAUSE projects, and how do they relate to post-CAUSE institutional support?
6. What policy changes and recommendations should be implemented in the CAUSE program?

The framework for the evaluation was selected to provide multiple perspectives of the CAUSE program and redundancy in the data collected. Broad, medium, and narrow focus methods were utilized and included: a survey of all project directors, 1976-78; an analysis of funded projects, 1976-79; two day site visits to 17 projects; repeated visits to eight projects to conduct case studies.

The objectives for this session are threefold: to present the conclusions resulting from data collection activities; to discuss recommendations for CAUSE made to NSF based on the conclusions; to reflect on the strengths and the problems with the data collection activities and the framework used. Paper

topics to be presented and discussed include an overview of the CAUSE program and the design used to evaluate it; conclusions from the narrow and medium focus data methods; reflections on the distinctions between and relative benefits of site visits and case studies; conclusions from and reflections on the broad view methods; recommendations for CAUSE made to NSF. The purpose of this session is to inform two audiences: one interested in instructional improvement at the postsecondary level, specifically science education improvement and one interested in the use of data collected from multiple perspectives, triangluation in data analysis, and the methods of site visiting and case study. The discussant, from the Office of Program Integration, NSF, monitored the evaluation project. She will discuss the conclusions, recommendations, and conduct of the evaluation from NSF's perspective.